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DOCKET: CU-2110 TJK

Assistant Commissioner for Patents  
Box PATENT APPLICATION  
Washington, D.C. 20231

Sir:

Transmitted herewith for filing is the patent application of:

Inventor: Scott L. BARHAM  
Title: FILTRATION AID FOR THE BAYER PROCESS

Enclosed are the following papers and documents required for filing date under 37 CFR 1.53(b):

- 9 Pages of specification  
 2 Pages of claim(s)  
 1 Pages of abstract  
 1 Sheets of drawing  
 Combined Declaration and Power of Attorney  
 An assignment of the invention to:  
 A certified copy of a  
 Verified Statement to establish small entity status under 37 CFR 1.9 and 37 CFR 1.27  
 Assignment Recordation Cover Sheet with accompanying fee  
 X Other: Preliminary Amendment

The filing fee has been calculated as shown below:

	(Col. 1)	(Col. 2)
FOR:	NO. FILED	NO. EXTRA
BASIC FEE		
TOTAL CLAIMS	17 -20 =	* 0
INDEP CLAIMS	2 -3 =	* 0
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENTED		

\*If the difference in Col. 1 is less than zero, enter "0" in Col. 2

SMALL ENTITY		OTHER THAN A SMALL ENTITY	
RATE	FEES	OR	RATE
	\$345.	OR	
x 9.	\$	OR x 18.	\$ 690.
x 39.	\$	OR x 78.	\$ -
+ 130.	\$	OR + 260.	\$ -
TOTAL	\$	OR TOTAL	\$ 690.

A check in the amount of \$ 690.00 to cover the filing fee is enclosed.

The Commissioner is hereby authorized to charge payment of any additional filing fees associated with this communication, or credit any overpayment to our Deposit Account No. 12-0400. A duplicate copy of this sheet is attached.

Respectfully submitted,

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jc135 U.S. PTO  
09/484071

01/18/00

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**IN THE UNITED STATES PATENT & TRADEMARK OFFICE**

APPLICANT: Scott L. BARHAM )  
TITLE: FILTRATION AID FOR THE BAYER PROCESS )

The Assistant Commissioner for Patents  
Washington, D.C. 20231

**PRELIMINARY AMENDMENT**

Dear Sir:

Please amend the application being filed herewith.

**IN THE SPECIFICATION:**

Page 5, line 15, delete "dispaly" and insert --display--.

**IN THE CLAIMS:**

Please amend claims 1-17 as follows:

1. A treating agent for use in the Bayer process in filtration of caustic sodium alumina solution, said treating agent comprising:

a blend of starch and another polysaccharide.

2. [A] The treating agent [as claimed in] of claim 1 wherein the polysaccharide is selected from the group consisting of pullulan, dextran, alginate, zooglan, lactan or mixtures thereof.

3. [A] The treating agent [as claimed in] of claim [1 or] 2 wherein the treating agent is dextran.

4. [A] The treating agent [as claimed in any one] of claim[s 1 to] 3 further incorporating a filter aid for assisting the filtration of the caustic sodium aluminate solution.

5. [A] The treating agent [as claimed in] of claim 4 wherein the filter aid

is calcium aluminate.

6. [A] The treating agent [as claimed in] of claim [4 or] 5 wherein the filter aid is a 12% aqueous suspension of calcium aluminate.

7. [A] The treating agent [as claimed in any one of the preceding claims] of claim 6 comprising up to 10 ppm of polysaccharide and 200-300 ppm of starch.

8. [A] The treating agent [as claimed in any one of the preceding claims] of claim 7 comprising up to 5 ppm of polysaccharide.

9. [A] The treating agent [as claimed in any one of the preceding claims] of claim 8 wherein the polysaccharide to starch ratio is between 9:1 and 1:9.

10. An improvement in the Bayer process wherein bauxite is added to a caustic solution to produce a slurry of sodium aluminate solution and an insoluble red mud fraction which is then subjected to a thickener and separation step to produce a thickener overflow, said [thickner] thickener overflow being [subjection] subjected to filtration, the improvement comprising:

providing a blend of starch and another polysaccharide to the [thickner] thickener overflow as a treating agent prior to said filtration.

11. [An] The improvement [as claimed in] of claim 10 wherein the polysaccharide is selected from the group consisting of pullulan, dextran, alginate, zooglan, lactan or mixtures thereof.

12. [An] The improvement [in the Bayer process as claimed in claim 10 or] of claim 11 wherein a filter aid is added to the thickener overflow to assist filtration.

13. [An] The improvement [as claimed in any one of claims 10 to] of claim 12 wherein the filter aid is calcium aluminate.

14. [An] The improvement [as claimed in any one of claims 10 to] of claim 13 wherein the filter aid is a 12% aqueous suspension of calcium aluminate.

15. [An] The improvement [as claimed in any one of claims 10 to] of claim 13 wherein the treating aid includes up to 10 ppm, of polysaccharide and 20-30 ppm of starch.

16. [An] The improvement [as claimed in any one of claims 10 to] of claim 15 wherein treating agent includes up to 5 ppm of polysaccharide.

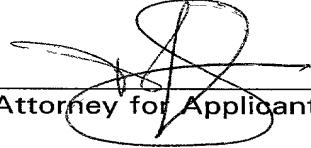
17. [An] The improvement [as claimed in any one of claims 10 to] of claim 16 wherein the polysaccharide to starch ratio in the treating agent is between 9:1 and 1:9.

**REMARKS**

The aforesaid claims have been amended to place the same in better condition for examination under U.S. rules of practice.

Respectfully submitted,

1/18/2000  
Date

  
\_\_\_\_\_  
Attorney for Applicant

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DOCKET: CU-2110 TJK

APPLICANT: Scott L. BARHAM

TITLE: FILTRATION AID FOR THE BAYER PROCESS

**INFORMATION SHEET**

**INVENTOR(S):**

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**PRIORITY (35 USC 119):**

Based on Australian Application PP8258 filed January 20, 1999.

Case 5594

## TECHNICAL FIELD

The present invention relates to treating agents and particularly to treating agents for  
5 filtration of caustic sodium aluminate solutions from the Bayer process.

## BACKGROUND ART

In the Bayer process, alumina is refined from bauxite ores. The process comprises  
digesting the ore in a caustic solution to extract alumina, clarifying the liquor to remove  
caustic insoluble red mud material and precipitating alumina crystals as its trihydrate form  
10 from the clarified liquor. Clarifying the liquor involves separating the solid particles from  
the liquor by settling and if necessary, filtration.

The clarified, filtered liquor is then cooled until it becomes super-saturated and  
seeded with crystals of alumina trihydrate. Alumina is precipitated as the trihydrate in  
tanks and the solids are classified by particle size. The coarse fraction of alumina  
15 trihydrate (primary) is then dewatered eg by rotary vacuum filters and washed to reduce its  
soda level. The alumina product is then transferred to calciners where any free or  
combined water is removed if it is intended that the alumina be used in the manufacture of  
aluminium metal. If the alumina is to be used in other applications, some of the free water  
will be removed but not necessarily the water of hydration.

20 As discussed in US patent no 5,091,159 (incorporated herein by reference), it has  
been found that dextran is a particularly suitable treating agent for filtration. The dextran is  
added to the liquor, which preferably already contains a calcium aluminate filter aid, in  
quantities of 0.5-15 mg/l as the only treating agent. This addition of dextran has been  
shown to give substantial improvements in filtration time.

Of course, in the quantities used in the Bayer process, such additions of dextran can be quite expensive.

The present invention seeks to overcome at least some of the disadvantages of the prior art or at least provide a commercial alternative thereto.

5       DISCLOSURE OF THE INVENTION

In a broad first aspect, the present invention provides a treating agent for use in the Bayer process in filtration of caustic sodium alumina solution said treating agent comprising a blend of starch and another polysaccharide.

Preferably, the polysaccharide of the treating agent is selected from the group  
10      consisting of pullulan, dextran, alginate, zooglan, lactan or mixtures thereof.

In another embodiment, the treating agent is used in conjunction with a filter aid in the filtration of the caustic sodium aluminate solution. Preferably the filter aid is calcium aluminate and most preferably a 12% aqueous suspension of calcium aluminate.

Such a filter aid is useful when the caustic sodium aluminate solution is filtered by a  
15      Kelly pressure filter. Such a filter aid may not be required in all circumstances, eg, where a sand filter is used to filter the caustic sodium aluminate solution.

In a further preferred embodiment, the treating agent comprises up to 10 ppm  
preferably up to 5 ppm of the polysaccharide and up to 200-300 ppm of starch.

In still another preferred embodiment, the treating agent comprises a polysaccharide  
20      to starch ratio of between 9:1 and 1:9.

In a further aspect, the present invention provides an improvement in the Bayer process wherein bauxite is added to a caustic solution to produce a slurry of sodium aluminate solution and an insoluble red mud fraction which is then subjected to a thickener and separation step to produce a thickener overflow, said thickener overflow being

subjected to filtration, the improvement comprising providing a blend of starch and another polysaccharide to the thickener overflow as a treating agent prior to said filtration.

The present applicant has surprisingly found that at least part of the polysaccharide normally used as a treating agent in the filtration step of the Bayer process can be replaced 5 with starch without any substantial loss in filterability. Indeed the addition of certain blends of polysaccharide and starch as a treating aid may result in increased filterability of the liquor as compared to polysaccharide alone as a filter aid.

Clearly this has significant advantages since starch is only a fraction of the cost of the aforementioned polysaccharides. Any replacement of the polysaccharide by a low-cost 10 product such as starch will substantially increase the commercial viability of the process.

Unless the context clearly requires otherwise, throughout the description and the claims, the words 'comprise', 'comprising', and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".

#### 15 BEST MODE FOR CARRYING OUT THE INVENTION

To illustrate the advantages of the invention the following results are presented by way of example only.

#### Test Series A and B

Filtration tests were conducted on the green liquor at a typical alumina plant using 20 the Bayer process plant, the results of which are shown in the table below.

The polysaccharide used was dextran as a 7% aqueous solution. The starch component was a 10% (100 g/l) aqueous solution produced by adding powder to 10 g/l sodium hydroxide and agitating at 60° for 15 minutes.

Two series of test were conducted. Series A had 10 tests (1A - 10A) and series B had 6 tests (1B-6B).

As shown in Table 1, for series A several different blends of the treating agent were used in the filtration tests. Test number 2A uses a simple aqueous solution of dextran with 5 no addition of starch. Tests 4A, 6A and 8A use varying dextran/starch ratios and test 10A uses a simple aqueous solution of starch. Each test was compared with a corresponding blank which did not use any treating agent.

As shown in Table 2, for series B, tests 2B, 4B and 6B similarly use varying dextran/starch ratios.

10 The times for filtering various quantities (50 ml, 100 ml and 150 ml) were measured. The filtration rates were then calculated and these rates compared with the corresponding blank to provide a percentage measure of the increase/decrease flotation rates (%50, %100 and %150).

15 It is clear from the results below that the blending of the polysaccharide treating agent with starch provides no real significant decrease in filterability of the green liquor and in fact in some instances provides an advantage.

For test series A when using an aqueous solution of dextran as the treating agent, there is an average improvement in filterability of around 52%. When starch, however, is mixed with the dextran there is a slight reduction in filterability but a substantial cost 20 saving. Tests 4A, 6A and 8A have an average improvement in filterability over their corresponding blank of around 37%, 41% and 46%. This compares very favourably with the pure dextran treating agents.

Series B testing provided even better results. Test 2B shows an average improvement in filterability of 46.1% where the treating agent is an aqueous solution of

dextran. Tests 4B and 6B show of 55% and 45% improvement in filterability when the dextran is mixed with 50% and 75% respectively of starch. This of course compares extremely favourably with the dextran treating agent.

Accordingly, it is clear that even small additions of starch to the polysaccharide 5 treating agent provide significant cost saving without any substantial reduction in the filterability of the green liquor. These results are quite surprising since, as shown in test 10A, using the treating agent made purely of starch ie without any dextran, provides no improvement in the filterability of the green liquor over an untreated liquor.

It is envisaged that the quantity of starch added to the polysaccharide may be quite 10 high, even as high as 9 times the quantity of polysaccharide since, as shown in tests 8A and 6B which have a dextran/starch ratio of 25/75, there is minimal effect on the filterability of the green liquor as compared with the pure dextran treating agent.

### Test Series C

Reference is also made to the results of Test Series C shown in Table 3 and Figure 1 15 which dispaly the effect of a dextran/starch ratio in liquor filtration.

These tests were conducted using a Nalco pressure filter. A 13% aqueous solution of dextran (85711) was mixed in various ratios with a 14% by weight solution of starch (PE200).

As a measure of the effectiveness of the treating agent, the resistance to filtration of 20 the filter medium (i.e. wire or cloth support) and the resistance to filtration of the cake (red mud) built up on the filter medium were both measured. Results are shown in Table 3 and Figure 1. Comparing test runs 2C, 4C and 5C which use the dextan/starch blend, it is apparent that there is little variation in the filter medium resistance or cake resistance as compared with run 1C which uses an aqueous solution solely of dextran as the treating

agent. In other words, once again starch may be added to the polysaccharide treating agent to provide a significant cost saving without any substantial reduction in filterability of the green liquor. Test 6C shows that this is quite surprising since the treating agent made solely of the aqueous starch solution does appear to substantially reduce the filterability, at 5 least in regard to cake resistance.

It will be clear to persons skilled in the art that the present invention may be embodied in other specific forms without departing from the spirit or scope of the inventive idea. For example, it is possible that dextran may be replaced by another polysaccharide such as pullulan, alginate, zooglan, lactan or mixtures thereof in the treating agent. It is 10 also envisaged that the present invention is suitable for various types of filtration in the Bayer process eg Kelly pressure filter, sand filter etc.

Table 1 - Test Series A

TEST	PRODUCT	PRODUCT RATIO	DOSE (PPM)	TIME FOR 50 MLS	TIME FOR 100 MLS	TIME FOR 150 MLS	RATE 50	RATE 100	RATE 150	% 50	% 100	% 150	Average
1A	Blank	-	0	50	141	278	1.00	0.71	0.54				
2A	85715/PE200	100/0	5	32	94	185	1.56	1.06	0.81	56.3	50.0	50.3	52.2
3A	Blank	-	0	46	120	210	1.09	0.83	0.71				
4A	85715/PE200	75/25	5	34	86	155	1.47	1.16	0.97	35.3	39.5	35.5	36.8
5A	Blank	-	0	57	140	238	0.88	0.71	0.63				
6A	85715/PE200	50/50	5	39	100	175	1.28	1.00	0.86	46.2	40.0	36.0	40.7
7A	Blank	-	0	57	137	233	0.88	0.73	0.64				
8A	85715/PE200	25/75	5	36	96	171	1.39	1.04	0.88	58.3	42.7	36.3	45.8
9A	Blank	-	0	57	131	216	0.88	0.76	0.69				
10A	85715/PE200	0/100	5	58	131	215	0.86	0.76	0.70	-1.7	0.0	0.5	-0.4

85715 - 7% aqueous solution of dextran

PE200 - 10% (100gpl) aqueous solution producing by adding powder to 10 gpl NaOH and agitating at 60°C for 15 mins

Table 2 - Test Series B

TEST	PRODUCT	PRODUCT RATIO	DOSE (PPM)	TIME FOR 50 MLS	TIME FOR 100 MLS	TIME FOR 150 MLS	RATE 50	RATE 100	RATE 150	% 50	% 100	% 150	Average
1B	Blank	-	0	75	190	335	0.67	0.53	0.45				
2B	85715/PE200	100/0	5	52	131	225	0.96	0.76	0.67	44.2	45.0	48.9	46.1
3B	Blank	-	0	76	185	316	0.66	0.54	0.47				
4B	85715/PE200	50/50	5	45	123	215	1.11	0.81	0.70	68.9	50.4	47.0	55.4
5B	Blank	-	0	82	188	320	0.61	0.53	0.47				
6B	85715/PE200	25/75	5	52	135	230	0.96	0.74	0.65	57.7	39.3	39.1	45.4

PE200 made as 10% (100gpl) solution by adding powder to 10gpl NaOH and agitating at 60°C for 15 mins.

85715 obtained from laboratory retain.

Combination of products make by simply blending together

Table 3 - Test Series C

Run#	%PE200	85711/ PE200**		Medium Resistance, 1/m		Cake Resistance, m/kg	
		Value	Stand. Error	Value	Stand. Error		
1C	0	100/0	1.93E+11	2.0E+08	1.88E+11	1.0E+09	
2C	25	75/25	1.90E+11	1.6E+08	1.44E+11	9.4E+08	
4C	50	50/50	9.34E+10	2.0E+08	9.44E+10	8.0E+08	
5C	75	25/75	1.97E+11	1.3E+08	2.27E+11	6.1E+08	
6C	100	0/100	2.27E+11	2.3E+08	3.33E+11	1.1E+09	
3C	Blank	1.86E+11	1.9E+08	3.67E+11	8.8E+08		

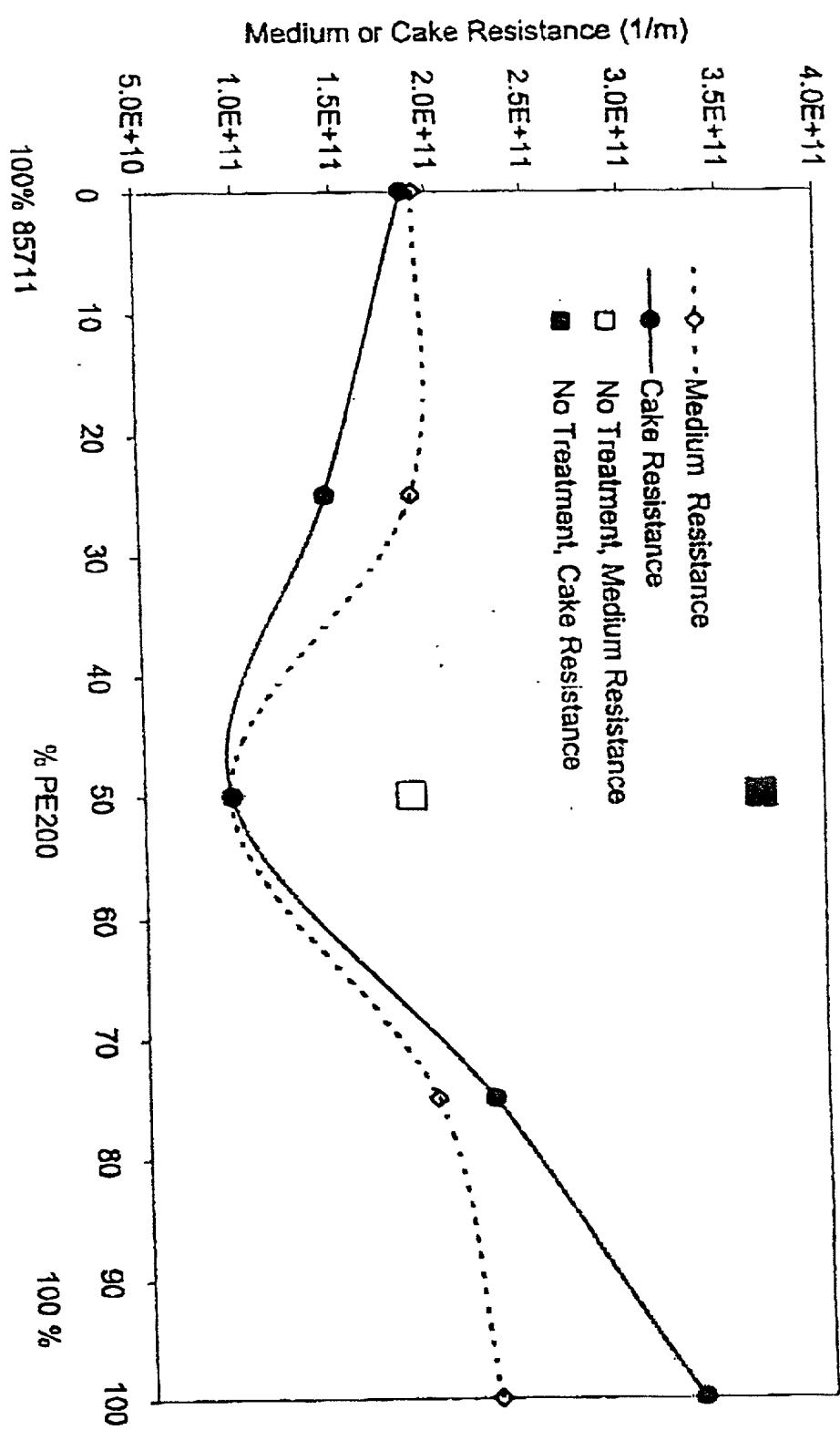
## THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A treating agent for use in the Bayer process in filtration of caustic sodium alumina solution, said treating agent comprising:
  - a blend of starch and another polysaccharide.
- 5 2. A treating agent as claimed in claim 1 wherein the polysaccharide is selected from the group consisting of pullulan, dextran, alginate, zooglan, lactan or mixtures thereof.
3. A treating agent as claimed in claim 1 or 2 wherein the treating agent is dextran.
4. A treating agent as claimed in any one of claims 1 to 3 further incorporating a filter aid for assisting the filtration of the caustic sodium aluminate solution.
- 10 5. A treating agent as claimed in claim 4 wherein the filter aid is calcium aluminate.
6. A treating agent as claimed in claim 4 or 5 wherein the filter aid is a 12% aqueous suspension of calcium aluminate.
7. A treating agent as claimed in any one of the preceding claims comprising up to 10 ppm of polysaccharide and 200-300 ppm of starch.
- 15 8. A treating agent as claimed in any one of the preceding claims comprising up to 5 ppm of polysaccharide.
9. A treating agent as claimed in any one of the preceding claims wherein the polysaccharide to starch ratio is between 9:1 and 1:9.
10. An improvement in the Bayer process wherein bauxite is added to a caustic solution to produce a slurry of sodium aluminate solution and an insoluble red mud fraction which is then subjected to a thickener and separation step to produce a thickener overflow, said thickner overflow being subjection to filtration, the improvement comprising:

providing a blend of starch and another polysaccharide to the thickener overflow as a treating agent prior to said filtration.

11. An improvement as claimed in claim 10 wherein the polysaccharide is selected from the group consisting of pullulan, dextran, alginate, zooglan, lactan or mixtures thereof.
12. An improvement in the Bayer process as claimed in claim 10 or 11 wherein a filter aid is added to the thickener overflow to assist filtration.
13. An improvement as claimed in any one of claims 10 to 12 wherein the filter aid is calcium aluminate.
- 10 14. An improvement as claimed in any one of claims 10 to 13 wherein the filter aid is a 12% aqueous suspension of calcium aluminate.
15. An improvement as claimed in any one of claims 10 to 13 wherein the treating aid includes up to 10 ppm of polysaccharide and 20-30 ppm of starch.
16. An improvement as claimed in any one of claims 10 to 15 wherein treating agent includes up to 5 ppm of polysaccharide.
- 15 17. An improvement as claimed in any one of claims 10 to 16 wherein the polysaccharide to starch ratio in the treating agent is between 9:1 and 1:9.

**Effect of 85711/PE200 Blend Ratio on Liquor Filtration**



**FIG. 1**

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